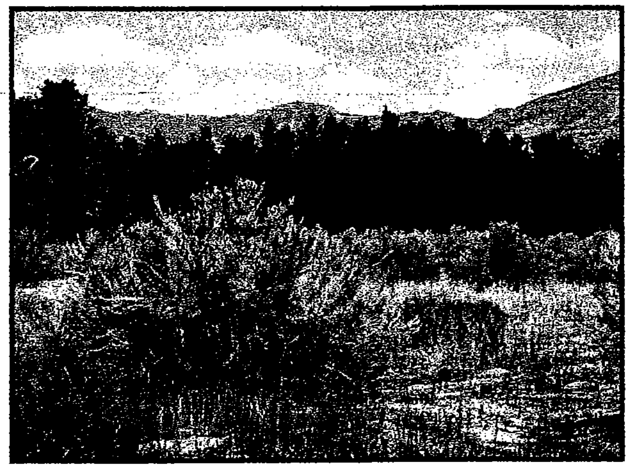
SOUTHWESTERN WILLOW FLYCATCHER IN THE CLIFF-GILA VALLEY

RESULTS OF SURVEYS AND NEST MONITORING



SUMMARY REPORT FOR THE 2003 FIELD SEASON

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Executive Summary

This report summarizes nest-monitoring and survey efforts for the Southwestern Willow Flycatcher (*Empidonax trailli extimus*) in the Cliff-Gila Valley, New Mexico during the 2003-breeding season. The population returned to the valley and began breeding in nearly identical numbers to the previous year, but the last surveys in late June and early July counted fewer flycatchers returning overall. The season's population total for the U-Bar declined to 124 pairs with an additional 11 unmated, territorial individuals detected, equivalent to 135 territories. The decline may be partly attributed to a continuation of severe drought and the previous season's low reproductive success rate (34.4%). Although the population declined on a whole, the number of flycatchers breeding in the Bennett project jumped to 25 pairs and an additional 2 unmated individuals, an increase of 79% from the previous year's count. The valley count included two pairs that were located in patches that had not been surveyed in past years.

Breeding activities rebounded from last season's disappointing high failure rate. We located and monitored 140 flycatcher nests of which, 46.3% were successful. At least four females successfully raised two broods and by following subsequent nest attempts by females, we found that 66% successfully raised at least one fledgling. We found that nests built in tree species other than boxelder (*Acer negundo*) and willow (*Salix spp.*) failed at a higher rate than expected.

The rate of brood parasitism by the Brown-headed cowbird (Molothrus ater) was higher than the previous 3 seasons (21.7%). Nest height affected the rate of brood parasitism and interestingly, the effect was opposite for the two most common substrates. When nest was placed in boxelder, the higher then nest was built, and/or the taller the boxelder, the lower the chance the nest had of being parasitized and when willow was used as nest substrate, the lower the nest was built, or the shorter the willow, the lower the chance it had of being parasitized.

The most common tree species used for nesting substrate was boxelder, but the rate of use declined for the second year to 59.2%. The migration of breeding flycatchers to younger riparian patches comprised of willow and cottonwood closer to the active river channel corresponds with sustained drought, which has resulted in a lowered water table and stressed vegetation in the larger, mature patches on terraces above the active floodplain. The booming population in the Bennett Project, which is comprised of all willow and cottonwood, contributes to increasing usage of willow as nesting substrate.

INTRODUCTION

BACKGROUND

The Southwestern Willow Flycatcher - The southwestern willow flycatcher is a small songbird that migrates to the southwestern United States to breed in dense riparian vegetation along river corridors. A decline in the number of the southwestern willow flycatcher resulted in the U.S. Fish and Wildlife Service listing the subspecies as Endangered in 1995 (USFW 2002). It is currently considered the top priority species for US Fish and Wildlife Service Region 2. Declines have been attributed primarily to a loss and alteration of riparian habitat associated with anthropomorphic influence on floodplains, including grazing, that resulted in a reduction of water levels and degraded habitat (USFW 2002). Brood parasitism by the brown-headed cowbird (*Molothrus ater*), a species associated with cattle, has also been listed as a threat to the flycatcher (Marshall and Stoleson 2000, USFW 2002), but cowbird parasitism may not be a primary threat to larger populations as long as adequate habitat is available and productivity rates are high enough to offset the adverse affects (Sedgwick and Iko 1999, USFW 2002, Rothstein et al. 2003).

The southwestern willow flycatcher is an obligate riparian species that chooses shady habitats adjacent to open water or saturated soil (Sedgwick 2000, Sogge and Marshall 2000, USGS 2002) for breeding. Habitat characteristics vary geographically and the common habitat requirements of the entire population have not been clearly defined (USFW 2002, Stoleson and Finch 2003). Recently published research has contributed some understanding of the flycatcher's habitat needs, although they may be unique to the region of study. Stoleson and Finch (2003) found that in the Cliff-Gila Valley, flycatcher presence was positively correlated with foliage density in the subcanopy, percent canopy cover, and number of boxelder stems. Allison et al. (2003) found that female flycatchers breeding on two sites in central Arizona preferentially built nests close to breaks in the canopy and in areas of the habitat with high foliage density at the nest height and below. Sedgewick and Knopf (1992) found flycatcher habitat was associated with abundance, density, and coverage of willows. These findings may be unique to each place of study but foliage structure is a common theme and may be the key to understanding the habitat preferences.

When a habitat is occupied, it is easy to assume the habitat is suitable or preferred but quality habitat is best measured by its influence on reproductive success (Wiens 1989). Productive habitat must provide for all of a species foraging and nesting needs. For the flycatcher, understanding habitat parameters that best contribute to productivity is important because of its endangered status and of effort to preserve and restore habitat specifically for the bird's recovery (USFW 2002).

Tyrannids (the family of Tyrant Flycatchers to which the Willow Flycatcher belongs) are notable for their aggressiveness in nest defense (Bent 1942). Selection of concealed nest sites and aggressive nest defense are methods by which rates of nest loss can be reduced (Murphy 1983). The structure of the habitat can contribute to both nest concealment and in providing an arena for the flycatcher in which to forage and defend it's nest. Strategic placement of a nest in a hidden location within a territory with open areas in the periphery may aid the flycatcher in aggressive nest defense (Murphy 1983). Canopy breaks may also provide sites for foraging for the willow flycatcher (Allison et al. 2003).

Although we cannot fully explain the habitat preferences of the flycatcher, canopy structure is emerging as an important factor. Understanding the structural characteristics that contribute to a more productive habitat is important direction for future research.

METHODS

Study Site

The Gila River Valley opens onto a broad alluvial floodplain as the river leaves the mountains of the Gila Wilderness. The upstream end of this wide valley begins at the Mogollon Creek inlet (33° 55' N, 108° 35' W) and from here the river runs south-southwest through the Cliff-Gila Valley for approximately 18 km. The study was primarily conducted from just below the US Route 180 Bridge upstream to the north end of the U-Bar Ranch along approximately 8 km of river (Figure 1). Most of the Cliff-Gila Valley consists of irrigated and non-irrigated pastures used for livestock production and hay farming. Elevations range from 1350 to 1420 m.

The project site is especially important geographically for Neotropical migratory birds. The valley supports southwestern riparian habitat and provides important breeding habitat for 11 of New Mexico Partners in Flight High Priority Species. The valley has been shown to support some of the highest non-colonial breeding bird densities north of Mexico (Stoleson and Finch 1997). Sections of the valley are included in New Mexico birding guides as an excellent spot for birding (Zimmerman *et al.* 1992, White 1999, Parmeter *et al.* 2002).

The Gila River and nearby earthen irrigation ditches are lined with riparian woodland patches that vary in composition depending on the age of the vegetation. Most mature patches support a woodland community of Fremont Cottonwood-Gooding Willow/Boxelder (*Populus fremontii-Salix gooddingii/Acer negundo*) (modified from Muldavin et al. 2000). This community type is well represented in the Cliff-Gila Valley and is characterized by a mature cottonwood overstory (>25m high) with a subcanopy dominated by stands of boxelder and Gooding's willow. In many stands the boxelder is the most common tree, forming a closed subcanopy gallery forest. Arizona walnut (*Juglans majoris),* velvet ash (*Fraxinus velutina)*, and Arizona sycamore (*Plantar wrightii)* occur as sub-canopy associates. The shrub layer is sparse because of the shade of the dense forest canopy but includes three-leaf sumac (*Rhus trilobata*), false indigo (*Amorpha fruticosa*), and New Mexico olive *(Forestieria neomexicana*). The groundcover consists of forbs and grasses. Most young patches support a Fremont Cottonwood-Gooding Willow/Coyote Willow (*Salix exigua*) community type (Muldavin et al. 2000). This type is typically found on low to mid-elevation bars within the active floodplain and often grows along inactive river channels. Narrow patches of young to middle-aged stands of cottonwood and Gooding willow with an understory dominated by coyote willow are characteristic. Saplings of boxelder and other wetland indicators such as seepwillow (*Baccharis salicifolia*) and bluestem willow (*Salix irrorata*) can be present in the understory.

Surveys for the Willow Flycatcher

Surveys for willow flycatchers were conducted in riparian habitat within each site using standardized survey techniques developed by U.S. Fish and Wildlife (Sogge et al. 1997, USFW 2000). Five surveys were conducted at each site; one survey between May 15 – June 1, one between June 1 – June 21, and three between June 22 – July 18, with no two surveys in one site being closer than 5 days apart. Surveys were conducted from dawn to 11:00 AM on clear, calm days. Surveyors walked through riparian patches or along the edge of narrow habitat, periodically playing taped recordings of the flycatcher's song to elicit responses from territorial males. We recorded the number of flycatchers detected, evidence of breeding, and presence of brown-headed cowbirds. The Rocky Mountain Research Station held current state and federal permits required for monitoring the Southwestern Willow Flycatcher, and all personnel attended mandatory survey protocol training held by the U.S. Fish and Wildlife before conducting fieldwork.

Nest Monitoring

Data on nesting activities were collected mid-May to the end of August. We conducted nest searches on a daily basis and nests were monitored every 3 – 7 days following a modification of Rourke *et al.* (1999). Flycatcher behavior, nest activity and nest contents were recorded on each visit. For nests below 5 – 6 meters, nest contents were observed with pole-mounted mirrors or video cameras to ascertain nest stage and presence/absence of cowbird eggs or chicks. Because it is difficult to handle the poles above 5 – 6 meters, high nests were monitored with binoculars from a distance and contents determined from adult activity at the nest. We used all necessary precautions to minimize human-impacts when conducting nest search and monitoring activities (Martin and Geupel 1993, Martin *et al.* 1997, Rourke *et al.* 1999). A nest was considered successful if: (1) at least one fledgling was visually confirmed near the nest, (2) adults displayed defensive or agitated behavior when the nest was empty, or (3) nestlings were observed in the nest within 2 days of the estimated fledging date. A nest was considered failed if: (1) the nest contents disappeared before fledging was possible (depredation), (2) the nest was abandoned, or (3) cowbird young survived longer than the flycatcher offspring (parasitized).

We documented renest attempts in order to estimate success per territory. Nests that were located near (<15m) to a previously active nest (often in the same tree), and whose dates of activity did not overlap the other nest, were documented as a renest. Observations of flycatcher activity, such as removing material from the inactive nest and using it to rebuild a new nest, help to confirm the status of the new nest as a renest. Seasonal fecundity, or the number of young fledged per pair in a season would have been a preferred calculation but it is difficult to assess and requires following the same individual through all nesting attempts (Stoleson et al. 2000). There have been evidence suggesting low levels of mate fidelity, even with-in the season (Paxton et al. 1997), and high levels of polygamy (Davidson and Allison 2003). Because very few of the flycatchers in the valley are color-banded, we would have been unable to assume the same individuals were nesting on each attempt and therefore did not attempt to calculate seasonal fecundity. An estimate of success per territory was substituted as an estimate of female productivity.

We recorded presence or absence of brood parasitism for all nests where it was possible to observe the nest contents. Brood parasitism rates were calculated as the number of nests that were confirmed as parasitized divided by the number of nests with known parasitism status.

Vegetation Sampling

Nest-site specific habitat data for the willow flycatchers was collected after the flycatchers had vacated their territories. We followed a modified version of the methods outlined by Rourke et al. (1999). Vegetation was sampled in an 8-m radius plot centered on flycatcher nests. Cover was estimated for the understory (0 – 1.5 m per Powell 2002), subcanopy (1.6 – 7.0 m per Rourke et al. 1999), and canopy (above 7.0 m) layers and categorized using the Braun-Blanquet cover-abundance scale (Rourke et al. 1999). Cover estimation was also broken down by vegetation species. Stems of each species were quantified in four categories of sapling diameters and four categories of tree diameter. We estimated average canopy height at the plot and measured substrate height, diameter at breast height (1.4 m), nest height, distance to water, distance to edge, and recorded tree species used as substrate.

To capture canopy structure we calculated a variety of diversity measures. We calculated Shannon Diversity index for the basal area of stems of both saplings and trees and for the three canopy layers (Neumann and Starlinger 2001). A diversity index integrates both species number and the relative abundance of species in each category. We calculated a Complexity Index that is based on stand description including canopy height, stem basal area and number, and the number of species (Neumann and Starlinger 2001). To characterize vertical structure we calculated a Vertical Evenness Index, which incorporates the relative crown area of all trees in each layer (Neumann and Starlinger 2001).

Each index and measured territory parameter was tested as a predictor to determine if any were correlated with nest outcome. Nest success and presence/absence of brood parasitism were the response variables of interest. The response data are represented by binary indicator variables so we used logistic nonlinear regression to build single-variable models. We applied ANOVA, using Chi-squared to test for significance of each model in determining nest outcome.

RESULTS

Climate in 2003

The Southwest has been experiencing a long-term drought and despite wet conditions in February and March that brought precipitation levels to 109% of normal for the state of New Mexico (NM Drought Monitoring Committee, April 2003 Report), conditions deteriorated over the summer season when the state experienced the driest June on record and the second hottest July on record (NM Drought Monitoring Committee, August 2003 Report). Water flows in the Gila River remained well below average for all but a few days in the summer season (USGS Stream Flow Data, Gauge 09430500 (Near Gila, NM)). Delay of normal monsoon precipitation, record high temperatures in July, and lowered water table from the drought were evident in the riparian patches, some boxelder trees on the high terraces exhibited precocious senescence as early as June.

Willow Flycatcher Population Surveys

The population of Willow Flycatchers on the U Bar Ranch declined from last years' survey totals, down from 156 pairs in 2002 to 124 pairs. We located 11 additional territorial flycatchers that never paired or nested in the territory, increasing the number of territories to 135 for 2003 (Appendix 1). Nest searchers monitored the territorial individuals until they mated or vacated the territory so we are certain there were no nest attempts in the territories.

The number of flycatchers that returned to areas above and below the U-Bar, including the Gila Bird Area and the land north from Fort West Ditch to Mogollon Creek, were considerably lower than the previous year, only one pair and 6 individuals were detected and although we monitored the areas, we didn't detect any nesting activity.

The occupancy in many of the patches were similar to 2002, notable exceptions were declines in Northwest-4 (NW4) and Southeast-1 (SE1), and an increase in the Bennett Project. The occupancy of the Bennett Project has increased exponentially (Figure 2) since it was first occupied in 1999. In 2002, the habitat in the Bennett Project supported 14 pairs and in contrast to the general low rates of nest success last season, the birds in the Bennett were relatively productive with a majority of the territories fledging young (see Brodhead *et al.* 2002). The population in 2003 reflected the relatively high rate of success with the population increasing to 25 pairs and 2 unmated territorial individuals. The higher numbers in the Bennett may also be responsible for the lower numbers in the adjacent NW4. We surveyed one patch (Southeast Zero) that had not been surveyed in the past and found one breeding pair. On reconnaissance to the east side of the river upstream from Northeast-5, we detected one nesting pair that was monitored until successfully fledging young and vacating their territory. The patch the pair occupied was not surveyed but the pair was counted in the population total.

Willow Flycatcher Breeding Outcome

Nesting Efforts - Of the 140 nesting attempts that we monitored, 65 were successful (46.4%), 73 failed (52.1%), and we were unable to ascertain the outcome of two (Table 2). These figures are calculated as simple or apparent nest success. Although apparent nest success tends to be positively biased because it does not take into account nests that failed quickly before they were discovered (Mayfield 1961, Mayfield 1975, Stanley 2000, Armstrong et al. 2002), the values underestimate seasonal success per territory. This is the number of territories that produced at least one fledgling during the breeding season. Per territory success was estimated at 66.3%. Of nine attempted a second-broods, four were successful (Figure 3). The prevalence of second-brood attempts and multiple renest attempts meant the flycatchers were present later in the season. The latest nest monitored was recorded as fledged on August 24th.

Brood Parasitism – The rate of brood parasitism by the Brown-headed Cowbird was 21.74%. This is relatively high for the Cliff-Gila Valley, second only to the rate in 1998 when compared with data dating back to 1997 (Figure 4). This rate is estimated from 92 nests with confirmed presence or absence of parasitism, but 47 nests were either too high to inspect contents or the nest was deconstructed by the female and used for rebuilding in a new location before we were able to confirm cowbird activity. The rate of brood parasitism may be slightly inflated because the nests that weren't inspected were generally the high nests and we found that high nests in boxelder had a lower probability of being parasitized (*see below*).

Willow Flycatcher Nest Sites

Unsurprisingly, a majority of flycatcher nests were built in boxelder but proportion of use has been on a downward trend since 2001 and this year the trend continued. The proportion of boxelder used as substrate declined to 59.7% and the use of willow increased slightly to 31.8% (Table 3). In 2002, boxelders were used 65.1%, and willows were used 30.2% of the time. This most likely reflects the relatively high number of nests built in the Bennett Project, which supports mostly a variety of young willow species and cottonwoods. Nests were built 6.7 meters high on average, a figure that is similar to 2002 (6.8 m) but below average for all seasons combined. The lower average is a direct result of more nests being built in the early-succession willow habitats. When nests were built in boxelder, they were 9.2 meters high on average and only 3.0 meters high for nests built in Gooding's willow (Table 3).

Effects on Nest Outcome – Statistical comparisons of failed and successful nests indicated the tree species in which the nest was built affected outcome, and comparisons of presence/absence of brood parasitism indicated that nest placement in the tree and tree height affected outcome. Chi-squared tests show that nests built in tree species other than boxelder and willow (*Salix spp.*) failed at a higher rate than expected ($p = 0.057$). Among nests built in boxelder, those that were built higher up were found to have a lower chance of being parasitized (ANOVA, Chi-squared test of the model vs. null, $p = 0.047$). In contrast, nests built in willows (*Salix spp.*) had a higher probability of being parasitized if they were built in taller trees ($p = 0.062$) or were built higher ($p = 0.087$). There is a difference in structure between the mature boxelders and the young willows used as substrate. The lower mean tree height and lower mean height of the nests in willows that were less likely to be parasitized may be explained by the higher foliage density on the young willow stems compared with older willow stems, and the denser foliage likely provides more camouflage to hide the nest.

We did not find any significant relationships between habitat structure in the territory and nesting success. Understory species diversity and sub-canopy species diversity were found to be slightly higher in territories with successful nests but the relationships were not significant.

DISCUSSION

Willow Flycatcher Population Trends in the Cliff-Gila Valley

Populations are affected by myriad factors including climate, competition, food availability, habitat quality, and migrant populations respond to these factors on both wintering and breeding grounds. The number of willow flycatchers occupying the Cliff-Gila Valley has fluctuated widely in the seven years of the project. Factors that drive these changes are likely multi-faceted and choice of which are responsible for changes in population is certainly a simplification of the truth. It is likely that climate, specifically drought, has played a role. Abundant water has been shown to be a critical factor affecting willow flycatcher settlement and nesting success (Sogge *et al.* 1997, Johnson *et al.* 1999). Drought affects vegetation and invertebrate populations and these in turn